

## PLATELET RICH PLASMA - IN CONTEXT OF PEDODONTICS

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**ABSTRACT:** Platelet Rich Fibrin (PRF) is referred to as a second-generation platelet concentrate, which has been shown to have several advantages over traditionally prepared Platelet Rich Plasma (PRP). PRF is a platelet concentrate which has been widely used to accelerate soft-tissue and hard-tissue healing. This article describes the various properties, mechanism of action and its use in pediatric dentistry in various treatment modalities.

**KEYWORDS:** Platelet Rich Fibrin, platelet concentrate, PRF

### INTRODUCTION

Platelet Rich Fibrin (PRF) first described by Choukrom et al.<sup>1</sup> in France, has been referred to as the second-generation platelet concentrate. It has many advantages over the traditional Platelet Rich Plasma (PRP) which is basically a platelet concentrate that is used widely to increase the healing, soft tissue as well as hard tissue.

Platelet Rich Fibrin has certain advantages like it is easy to prepare and doesn't have any biochemical handling of blood, so its preparation is strictly autologous. Platelet Rich Fibrin, a platelet gel helps in wound healing, bone growth and maturation, graft stabilization, wound sealing and hemostasis. It can also be used as a membrane<sup>2</sup>. If we compare Platelet Rich Plasma to Platelet Rich Fibrin, in PRF there is no need of adding anti-coagulant as well as the need to neutralize it. Also in PRF, there is no need of bovine-derived thrombin for helping in conversion of fibrinogen to fibrin. This conversion takes place slowly with small quantities of physiologically available thrombin from the blood itself.<sup>3</sup> It saw an important point coming up which was, the tissue oxygenation which became important for wound healing. This oxygenation enhanced the phagocytic and bactericidal ability of the immune system of the host cells; also it helps in supporting the protein as well as collagen synthesis. Growth factors can be important in enhancing the wound healing. Also there is an important link between growth factors and tissue oxygenation<sup>3</sup>.

An important area of latest research is tissue engineering where in a device containing viable cells and biologic mediators (growth factors and adhesins) can be synthesized in a lab, in a synthetic or biological matrix. This device can be implanted in patients and it can help or facilitate regeneration of particular tissues<sup>2</sup>. In summation, tissue engineering is a combination of three key elements,

1. Scaffolds (collagen, bone mineral)
2. Signaling molecules (growth factors)
3. Cells (osteoblasts, fibroblasts)

This latest concept of reconstructive biology, has already found widespread application in several branches of dentistry, such as periodontics, oral & maxillofacial surgery, and oral implantology.

In all kinds of soft tissue or bone healing, the first point is the formation of blood clot, which is important to start the healing process. So, Platelet Rich Plasma can be used as a simple method which helps in concentrating platelets in other words enrich blood clot which further enhances, also increases the healing. Natural clot has 95% Red Blood Cells, 5% Platelets and less than 1% White Blood Cells and many fibrin strands. A Platelet Rich Plasma blood clot contains 4% Red Blood Cells, 95% Platelets and 1% White Blood Cells.

The growth factors obtained from PRP also interact with other growth factors, which results in activation of gene expression and protein production<sup>4</sup>. 1970s described a component called Fibrin Glue which was a product of polymerization of fibrinogen with thrombin and calcium. Originally prepared using plasma from the donor was less stable due to low concentration of fibrinogen in plasma. These adhesives are also available commercially, but carry a small risk of disease transmission.

### PREPARATION

Required quantities of blood are drawn into 10ml test tubes without any anti-coagulant, and it is immediately centrifuged for 12 minutes at 2700rpm<sup>5</sup>  
Consists of 3 Layers

1. Top most acellular PPP
2. Platelet Rich Fibrin clot in middle
3. Red Blood Cells at the bottom

Platelet Rich Plasma also called “buffy coat” can be prepared by 2<sup>nd</sup> technique.

1. General Purpose – Cell Separators
2. Platelet Concentrating – Cell Separators

Requires large quantities of blood (450ml) – in a hospital setting

#### AVAILABILITY

PRP / PRF can be obtained by sequestering and concentrating platelets by gradient density centrifugation.

#### CONSTITUENTS OF PLATELET RICH PLASMA

PRP has a high concentration of fibrinogen as the main constituent. If calcium chloride is added to PRP, alpha granules of platelets including high concentration of factors are released, which are a diverse group of polypeptides called as growth factors, which have important roles in regulation of the growth and development of many tissues<sup>4</sup>.

A list of various growth factors released from PRP has been cited in **Table 1**.

#### PROPERTIES OF PLATELET RICH PLASMA

Following are the properties of PRP:

1. It helps in increasing collagen synthesis.
2. It helps in increasing osteogenesis.
3. It helps in increasing the vascularity of the tissues by increasing angiogenesis.
4. It helps in increasing epithelial cell and granulation tissue production.
5. It has antimicrobial effect.

PRP / PRF show no injurious effect on tissues. It also helps in release of growth factors. The growth factors are an important entity for the regulation and stimulation of the wound healing procedure. These factors when interact with each other, they form a cascade with multiple pathways, this leads to protein production.

#### MECAHNISM OF ACTION – PRP

- Platelet Rich Plasma inhibits inflammation by decreasing early macrophage proliferation.

- It also helps in release of growth factors from agranules found in platelets containing prepackaged growth factors.

It also helps in producing more number of cells, according to Carlson<sup>6</sup> (2002), as the injury happens, the platelets start to collect around the wound and get stuck to the exposed collagen proteins and cause release of the granules containing adenosine di-phosphate, serotonin and thromboxane, leading to hemostasis

#### PLATELET RICH PLASMA/PLATELET RICH FIBRIN - USES IN PEDIATRIC DENTISTRY

The advantage with PRP/PRF is stimulation and healing of the tissues, this could help in PRP/PRF finding a major place in various treatment modalities done in pediatric dentistry.

##### Pulp Capping

Platelet Rich Plasma could be an effective material used for direct pulp capping due to its excellent wound healing, tissue regeneration & osteogenic properties

Many researchers have proven that pulp tissue contains highly proliferative and clonogenic population of progenitor/stem cells which can differentiate into hard tissue forming cells on injury. (Nakashima, 2005)<sup>14</sup>

Pulp Capping in carious teeth can be unpredictable, therefore case selection can be an important criterion (Bashutski and Wong, 2008)<sup>12</sup>. Important criterion for successful outcomes is type and location of injury, age of the tooth, the treatment modality and integrity of cavity restoration.<sup>7</sup>

##### Pulpotomy

Cytotoxicity and mutagenic effects have always been major disadvantages discovered with the use of formocresol, as a pulpotomy agent. Platelet Rich Plasma with its low toxic effects and increased tissue regeneration showed excellent clinical results.

A study conducted by Damle et al<sup>8</sup>, in 2004 compared PRP and Calcium Hydroxide and found 100% success rate with Platelet Rich Plasma. Another study with Nagasaki et al.<sup>9</sup> in 2007 compared PRP vs Hydroxiapetite crystals, and found PRP to be much superior.

Hellig et al<sup>10</sup> in 1984, and Waterhouse<sup>11</sup> in 2000 gave the criterion for tooth selection in pulpotomy using Platelet Rich Plasma. Other than the usual criterion like symptoms

TABLE 1: SUMMARY OF GROWTH FACTORS RELEASED FROM PLATELETS

Growth Factor	Origin Cells	Recipient	Action
PDGF	Platelets, endothelial cells, macrophages, monocytes, Smooth muscle cells.	Fibroblasts, glial cells, macrophages/neutrophils smooth muscle cells	Collagenase Secretion Collagen Synthesis Stimulates macrophage and neutrophils
TGF-b	Platelets, Macrophages/monocytes, T-lymphocytes, neutrophils.	Fibroblasts, endothelial cells, epithelial cells, preosteoblasts, stem cells (marrow)	Stimulates osteoblasts, fibroblasts Collagen synthesis Collagenase secretion
PDEFG	Platelets, monocytes macrophages	Fibroblasts, Endothelial cells, epithelial cells.	Collagen secretion Mitogenesis of epithelial cells Chemotaxis
PDAF	Platelets, Endothelial cells.	Endothelial cells	Increases permeability of vessels Increases angiogenesis Cartilage growth,
IGF-1	Osteoblasts, macrophages, monocytes, chondrocytes	Fibroblasts, osteoblasts, chondrocytes.	Replication of preosteoblasts and osteoblasts, Bone matrix formation,
PF-4	Platelets	Fibroblasts, neutrophils	Attracts neutrophils and fibroblasts

indicative of advanced pulpal inflammation, or symptoms suggesting a non vital tooth, pulp necrosis, periapical pathology, internal resorption, they also suggested that an important criterion could be that hemorrhage stops within 5 minutes from amputated pulp stumps, using a sterile pledget of moist cotton.

**Apexogenesis**

Apexogenesis is mainly performed to preserve the pulp vitality, as pulp has the reserve of cells which have regenerative properties. As explained earlier, PRP is an autologous source of many growth factors, which can induce stem cells and thus can lead in the regeneration of the tissues<sup>13</sup>.

**Extraction Socket**

PRP has been shown to have tissue regenerative and wound healing properties. Thus it can be an effective medium for helping in natural clot formation and initiate rapid healing. Also by increased re-vascularization and re-epithelization, it can also help in faster osteogenesis.

**PRP / PRF – USES IN OTHER BRANCHES OF DENTISTRY**

**1. Periodontal Surgeries**

As discussed earlier PRP helps in faster tissue healing as well as various tissue regeneration and

Osteogenesis. Hence it finds a major place in Periodontal Surgeries.

**2. Implantology**

Packing PRP/PRF along with implant in the socket would enhance healing.

**3. Oral and Maxillofacial Surgeries.**

Packing PRP/PRF enhances healing in maxillofacial surgeries.

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